

WHAT IS CLAIMED IS:

- 1 1. A method of etching silicon carbide, comprising:
2 providing a silicon carbide substrate;
3 forming a non-metallic mask layer by applying a layer of material on the
4 substrate;
5 patterning the mask layer to expose underlying areas of the substrate; and
6 etching the underlying areas of the substrate with a plasma at a first rate, while
7 etching the mask layer at a rate lower than the first rate.
- 1 2. The method of claim 1 wherein providing a silicon carbide substrate
2 comprises providing a substrate having a layer of polycrystalline silicon carbide disposed
3 thereon.
- 1 3. The method of claim 2 wherein providing a silicon carbide substrate
2 comprises providing a substrate having a layer of polycrystalline 3C-SiC disposed thereon.
- 1 4. The method of claim 1 wherein forming a mask layer comprises
2 applying a layer of silicon dioxide to the substrate.
- 1 5. The method of claim 4 wherein applying a layer of silicon dioxide
2 comprises depositing the silicon dioxide layer using a low pressure chemical vapor deposition
3 ("LPCVD") process.
- 1 6. The method of claim 5 wherein said LPCVD deposition process is
2 carried out by using SiH₄ and O₂ gases at a temperature of approximately 450 Deg. C in a
3 LPCVD furnace.
- 1 7. The method of claim 1 wherein forming a mask layer comprises
2 applying a layer of silicon nitride to the substrate.
- 1 8. The method of claim 7 wherein applying a layer of silicon nitride
2 comprises depositing the silicon nitride layer using a low pressure chemical vapor deposition
3 ("LPCVD") process.

1 9. The method of claim 8 wherein said LPCVD deposition process is
2 carried out using NH₃ and SiH₂Cl₂ gases at a temperature of approximately 835 Deg. C in a
3 LPCVD furnace.

1 10. The method of claim 1 wherein patterning a mask layer comprises
2 applying a photoresist layer to the mask layer and hard baking the photoresist layer.

1 11. The method of claim 1 wherein etching the underlying layer comprises
2 using a non-fluorinated gas etch chemistry.

1 12. The method of claim 1 wherein etching the underlying layer comprises
2 using a hydrogen and bromine etch chemistry.

1 13. The method of claim 1 wherein etching the underlying layer comprises
2 using a hydrogen bromide etch chemistry.

1 14. The method of claim 13 further comprising using a chlorine etch
2 chemistry.

1 15. The method of claim 14 wherein etching comprises flowing hydrogen
2 bromide at a rate of approximately 100 standard cubic centimeters per minute (sccm) and
3 flowing chlorine at a rate between 50 and 125 sccm into a plasma chamber.

1 16. The method of claim 13 further comprising using a chlorine and
2 oxygen etch chemistry.

1 17. The method of claim 1 wherein said etching comprises forming a high
2 density plasma using hydrogen bromide etch chemistry, where a high density plasma is a
3 plasma providing sufficient plasma densities to etch sub-micron features while reducing
4 surface damage.

1 18. The method of claim 1 wherein said etching comprises forming a high
2 density plasma using hydrogen bromide etch chemistry, where a high density plasma is a
3 plasma having an ion density of 10¹⁰ to 10¹³ ions per cubic centimeters.

1 19. The method of claim 1 wherein said etching comprises forming a high
2 density plasma using hydrogen bromide etch chemistry using an inductively coupled plasma
3 source.

1 20. The method of claim 19 wherein said forming comprises flowing said
2 hydrogen bromide gas at a flow rate of approximately 100 standard cubic centimeters per
3 minute in a chamber having a source power source and a bias power source.

1 21. The method of claim 20 comprising applying a source power between
2 200 and 500 watts, and applying a bias source power between 50 and 250 watts.

1 22. The method of claim 1 wherein said etching comprises removing the
2 silicon carbide at a rate between 30 and 120 nm per minute.

1 23. The method of claim 1 wherein said etching comprises removing the
2 silicon carbide at a rate of at least 100 nm per minute.

1 24. The method of claim 1 wherein said etching comprises removing the
2 silicon carbide at an etch rate ratio between 1:1 and 20:1 with respect to a silicon dioxide
3 mask layer.

1 25. The method of claim 1 wherein said etching comprises removing the
2 silicon carbide at an etch rate ratio between 1:1 and 22:1 with respect to a silicon nitride mask
3 layer.

1 26. A micromechanical device fabricated by a method, comprising:
2 providing a silicon substrate;
3 depositing a silicon nitride isolation layer on the substrate;
4 growing a doped polycrystalline silicon film on the silicon nitride layer;
5 depositing a silicon dioxide sacrificial layer on the polycrystalline film;
6 depositing a silicon carbide layer on the silicon dioxide layer;
7 forming a silicon dioxide mask layer on the silicon carbide layer;
8 etching the silicon carbide film in a high density plasma chamber using a
9 hydrogen bromide chemistry; and
10 releasing the device by etching the silicon dioxide sacrificial layer using an
11 hydrofluoric acid release etch process.

1 27. The device of claim 26 wherein said device is a microelectrmechanical
2 resonator.

1 28. A semiconductor device, comprising:
2 a silicon carbide substrate;
3 a non-metallic mask layer disposed on said silicon carbide layer for patterning
4 said silicon carbide layer; and
5 a photoresist layer for patterning said non-metallic mask layer.

1 29. The device of claim 28 wherein said silicon carbide substrate
2 comprises a silicon carbide layer disposed on a silicon substrate.

1 30. The device of claim 28 wherein said nonmetallic mask layer comprises
2 one of a silicon dioxide or silicon nitride layer.

1 31. A method of etching silicon carbide, comprising:
2 providing a silicon carbide substrate;
3 forming a non-metallic mask layer by applying a layer of material on the
4 substrate;
5 patterning the mask layer to expose underlying areas of the substrate; and
6 etching the underlying areas of the substrate with a plasma using a hydrogen
7 bromide etch chemistry at a first rate, while etching the mask layer at a rate lower than the
8 first rate.

1 32. The method of claim 31 wherein forming a mask layer comprises
2 applying a layer of silicon dioxide to the substrate.

1 33.. The method of claim 31 wherein forming a mask layer comprises
2 applying a layer of silicon nitride to the substrate.